

UNCLASSIFIED

AD NUMBER

AD769225

LIMITATION CHANGES

TO:

Approved for public release; distribution is unlimited.

FROM:

Distribution authorized to U.S. Gov't. agencies and their contractors; Critical Technology; NOV 1970. Other requests shall be referred to Navy Weather Research Facility, Norfolk, VA. This document contains export-controlled technical data.

AUTHORITY

NWRF per DTIC form 55

THIS PAGE IS UNCLASSIFIED

THIS DOCUMENT IS SUBJECT TO SPECIAL
EXPORT CONTROLS AND EACH TRANSMITTAL
TO FOREIGN GOVERNMENTS OR FOREIGN
NATIONALS MAY BE MADE ONLY WITH PRIOR
APPROVAL OF NAVY WEATHER RESEARCH
FACILITY.

NAVWEARSCHFAC Technical Paper No. 23-70

LIBRARY
TECHNICAL REPORT SECTION
NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA 93940

NO FORN

SPACE-TIME INVENTORY OF WESTERN NORTH PACIFIC TROPICAL STORM AND TYPHOON FREQUENCIES

by

SAMSON BRAND



**NAVY WEATHER RESEARCH FACILITY
BLDG.R-48, NAVAL AIR STATION
NORFOLK, VIRGINIA 23511**

NOVEMBER 1970

U0135837

Title: Space-Time Inventory of Western North Pacific Tropical Storm and Typhoon Frequencies.

AD Number: AD0769225

Corporate Author: NAVY WEATHER RESEARCH FACILITY NORFOLK VA

Personal Author: Brand, Samson

Report Date: November 01, 1970

Media: 18 Page(s)

Distribution Code: 01 - APPROVED FOR PUBLIC RELEASE

Report Classification: Unclassified

Source Code: 254370

From the collection:

Technical Reports

attached to

U135837

NAVY WEATHER RESEARCH FACILITY
BLDG. R-48, NAVAL AIR STATION
NORFOLK, VIRGINIA 23511

NO FORM

IN REPLY REFER TO

NWRF/RSH:je
5605.4
Ser: 810
20 November 1970

From: Commanding Officer, Navy Weather Research Facility
To: Commander in Chief, U.S. Pacific Command
Commander, U.S. SEVENTH Fleet
Commander, U.S. Naval Support Force, Vietnam
Commanding Officer, U.S. Fleet Weather Central/Joint
Typhoon Warning Center, Guam

Subj: Meteorological Research Report; forwarding of

Ref: (a) FLEWEACEN/JTWC Guam ltr JFS:np 3140 ser 67 of
18 Feb 1966 (NOTAL)
(b) COMNAVSUPPACT Danang ltr NK/DAM:hl 3142 ser
318/4536 of 24 Nov 1967 (NOTAL)
(c) COMSEVENTHFLT conf ltr FF/7/CLA:rh 3140 ser
N36-0401 of 1 Dec 1967 (NOTAL)
(d) CINCPAC ltr 389 ser 2187 of 8 May 1969 (NOTAL)

Encl: (1) "Space-Time Inventory of Western North Pacific
Tropical Storm and Typhoon Frequencies," NAV-
WEARSCHFAC Tech. Paper No. 23-70, Nov 1970

1. Enclosure (1) is forwarded in further response to references (a), (b), (c) and (d).

G. D. HAMILTON

Copy to (w/encl):
CHNAVMAT (MAT-03)
CINCPACFLT
CNO (Op-07)
COMNAVAIR
COMNAVWEASERV
CO FLENUMWEACEN
CO FLEWEACEN Pearl Harbor
CO FLEWEAFAC Jacksonville
CO FLEWEAFAC Sangley Point
CO NAVSUPPFAC Danang
NAVWEASERVCOMREP LANT
NAVWEASERVCOMREP PAC
NAVWPSSENGSUPPACT
OIC NWSER Asheville

NWRF/RSJ:je
5605.4
Ser: 810
20 November 1970

OIC WEARSCHFACDET Suitland
SUPNAVPGSCOL
Comdr AFCRL
Comdr AIRWEASERV
Comdr ETAC
Comdr 1st WEAWG
Director NHC
Director NHRL
Director NCC

1. INTRODUCTION

The inventory frequencies presented in this publication represent an aid to the forecaster in using the WEARSCHFAC typhoon analog-selection computer program¹. The analog program is a rapid, objective, computerized scheme for selecting, from among 1945-1969 tropical storms and typhoons, those storms (and their tracks) which most nearly resemble an existing tropical cyclone. This information can be used in conjunction with conventional prediction techniques to forecast tropical cyclone movement.

The analog program requires certain basic input information. The input data are of three types. First, the user is required to specify the space-time dimensions of the "envelope" to be searched for past tropical cyclones. Second, the user must specify weighting factors which assign relative importance to each of the 18 analog elements for measuring the extent to which the present storm is similar to past tropical cyclones. The third input consists of data for the existing storm to be compared with each of the 18 analog-data elements.

This report should provide useful information for the first type of input data (that is, space-time dimensions) to ensure that an adequate number of analogs (past storms) are found in the analog-search program.

¹"A Computer Technique for Using Typhoon Analogs as a Forecast Aid," by J. D. Jarrell and W. L. Somervell, Jr., NAVWEARSCHFAC Tech. Paper No. 6-70, June 1970.

Independently, these frequencies can by themselves serve as a useful climatological aid and thus may not be limited in use to the analog-selection computer program.

2. INVENTORY OF WESTERN NORTH PACIFIC TROPICAL STORMS AND TYPHOONS (1945-1969)

The following semi-monthly tables present a tropical storm and typhoon inventory for the space-time dimensions centered on the 1st and 16th of each month about grid points located at every 10° of latitude (from 10° N. to 50° N.) and 15° of longitude (from 110° E. to 175° W.) in the western North Pacific.

The inventory itself is a count of the number of storms located in the various space-time envelopes based on 6-hourly positions for the tropical storms and typhoons from 1945-1969. The space-time envelopes are defined as follows:

A - $\pm 2^\circ$ latitude and $\pm 3^\circ$ longitude and ± 12 days of date

B - $\pm 3^\circ$ latitude and $\pm 4.5^\circ$ longitude and ± 18 days of date

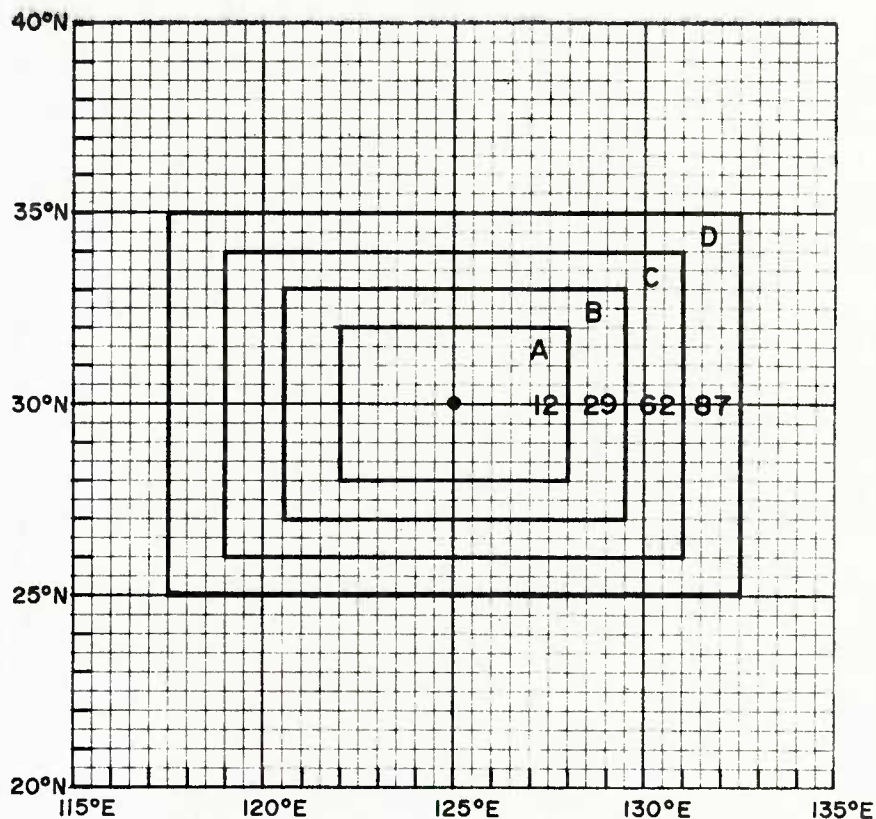
C - $\pm 4^\circ$ latitude and $\pm 6^\circ$ longitude and ± 24 days of date

D - $\pm 5^\circ$ latitude and $\pm 7.5^\circ$ longitude and ± 30 days of date

A storm must meet all three conditions (latitude, longitude and time limit) to be counted in A, B, C or D, respectively. Each storm was counted a maximum of one time in any latitude-longitude area. The frequencies are cumulative from A thru D.

For example, the following information can be obtained from the table with date/time centered about 16 August and the grid point located at 30° N., 125° E.:

DATE LAT	LON	A	16 August		
			B	C	D
30	125	12	29	62	87



- (a) Twelve tropical storms and/or typhoons passed through the area from 28° N. to 32° N. and 122° E. to 128° E. from 4 August to 28 August in the years 1945-1969, based on 6-hourly position data.
- (b) As the space-time dimensions are increased to the limits set forth by B, C and D, then 29, 62 and 87 storms, respectively, are counted within these respective limits.

Linear interpolation may be used to determine the storm count for space and time values other than those discrete space-time points given in the following tables.

The inventories presented in this paper were compiled for WEARSCHFAC by the National Weather Records Center.

Semi-Monthly Inventory of Western North Pacific Tropical Storms and Typhoons (1945-1969) For the Space-Time Dimensions Centered on the 1st and 16th of Each Month About Grid Points Located at Every 10° of Latitude and 15° of Longitude, From 10° N. to 50° N. and from 110° E. to 175° W.

Note: Grid points were not listed if the storm counts in classes A, B, C and D were all zero.

		1 JANUARY			
DATE	LON	A	B	C	D
LAT					
10 N	110 E	1	4	4	6
10	125	1	2	2	2
10	140	1	3	9	11
10	155	1	3	5	5
10	170	1	3	3	3
20 N	110 E	0	0	0	1
20	125	1	3	11	14
20	140	2	7	8	15
20	155	0	0	4	6
20	170	0	0	0	1
30 N	125 E	0	0	0	2
30	140	1	1	1	3
30	155	0	0	2	4
40 N	155 E	0	0	0	1
40	170	0	0	0	1

		16 JANUARY			
DATE	LON	A	B	C	D
LAT					
10 N	110 E	0	1	2	9
10	125	1	3	8	10
10	140	1	2	3	4
10	155	1	2	2	2
10	170	1	2	2	2
20 N	125 E	0	1	2	5
20	140	1	3	4	8
20	155	0	0	3	4
30 N	125 E	0	0	0	1
30	140	0	1	1	1
30	155	0	0	0	2

		1 FEBRUARY			
DATE	LON	A	B	C	D
LAT					
10 N	110 E	0	1	1	2
10	125	1	3	5	6
10	140	1	2	3	5
10	155	0	2	4	4
10	170	0	2	3	3
20 N	125 E	0	1	1	2
20	140	1	2	2	4
20	155	0	0	1	2

		16 FEBRUARY			
DATE	LON	A	B	C	D
LAT					
10 N	110 E	0	1	1	1
10	125	1	5	6	7
10	140	1	3	5	9
10	155	1	2	4	6
10	170	0	1	2	4
20 N	125 E	0	0	0	2
20	140	0	0	1	3
20	155	0	0	1	1

DATE LAT	LON	1 MARCH			
		A	B	C	D
10 N	110 E	0	1	1	1
10	125	1	2	3	3
10	140	1	5	6	7
10	155	1	3	4	4
10	170	0	1	4	5
20 N	125 E	0	0	0	1
20	140	0	0	0	2
20	155	0	0	2	2
30 N	155 E	0	0	0	1
30	170	0	0	0	1

DATE LAT	LON	16 MARCH			
		A	B	C	D
10 N	110 E	0	0	1	3
10	125	1	2	4	4
10	140	1	2	2	3
10	155	1	3	7	11
10	170	1	3	5	7
20 N	110 E	0	0	0	1
20	125	0	0	2	5
20	140	0	1	1	4
20	155	0	2	2	2
30 N	155 E	0	0	0	1
30	170	0	0	1	1

DATE		1 APRIL			
LAT	LON	A	B	C	D
10 N	110 E	1	2	2	2
10	125	0	3	10	13
10	140	1	4	4	5
10	155	1	2	3	3
10	170	1	3	5	6
20 N	110 E	0	0	0	1
20	125	1	4	7	8
20	140	0	1	5	9
20	155	0	2	2	4
30 N	125 E	0	0	1	1
30	155	0	0	1	2
30	170	0	0	1	1
40 N	155 E	0	0	1	1

DATE		16 APRIL			
LAT	LON	A	B	C	D
10 N	110 E	1	2	2	2
10	125	1	2	2	2
10	140	1	4	5	8
10	155	1	2	2	2
10	170	0	0	3	3
20 N	110 E	0	0	0	2
20	125	2	6	8	9
20	140	2	3	6	14
20	155	0	1	4	6
30 N	125 E	0	1	2	2
30	140	0	0	1	4
30	155	0	1	2	5
30	170	0	0	2	3
40 N	155 E	1	1	1	1
40	175 W	0	0	0	1

DATE		1 MAY			
LAT	LON	A	B	C	D
10 N	110 E	0	0	2	4
10	125	1	2	2	2
10	140	1	10	13	18
10	155	1	2	5	8
10	170	0	0	0	1
20 N	110 E	1	2	3	6
20	125	0	6	11	19
20	140	3	8	11	17
20	155	2	3	5	5
30 N	110 E	0	0	0	1
30	125	0	1	3	7
30	140	2	4	7	11
30	155	0	1	3	5
30	170	1	2	2	2
40 N	125 E	0	0	0	1
40	140	0	0	0	1
40	155	1	1	1	1
40	175 W	0	0	0	1

DATE		16 MAY			
LAT	LON	A	B	C	D
10 N	110 E	0	0	1	2
10	125	1	2	3	4
10	140	1	5	8	14
10	155	1	2	3	3
20 N	110 E	1	4	7	10
20	125	4	12	20	25
20	140	4	9	14	22
20	155	2	3	5	5
30 N	110 E	0	0	0	2
30	125	1	4	7	12
30	140	3	8	17	21
30	155	1	1	4	6
30	170	2	2	2	2
40 N	125 E	0	0	0	1
40	140	0	1	1	4
40	155	0	0	2	2
40	175 W	0	0	0	1

DATE		1 JUNE			
LAT	LON	A	B	C	D
10 N	110 E	0	0	1	2
10	125	1	5	6	13
10	140	1	3	7	7
10	155	0	1	4	8
20 N	110 E	2	7	10	16
20	125	7	18	30	39
20	140	0	10	16	24
20	155	0	1	4	5
30 N	110 E	0	0	0	2
30	125	2	8	15	20
30	140	9	15	22	26
30	155	1	1	2	5
30	170	0	1	1	2
40 N	125 E	0	0	2	4
40	140	0	1	3	8
40	155	1	1	1	1
40	175 W	0	0	0	1

DATE		16 JUNE			
LAT	LON	A	B	C	D
10 N	110 E	0	0	0	4
10	125	0	6	22	37
10	140	1	2	3	4
10	155	0	2	4	6
20 N	110 E	2	8	17	28
20	125	13	30	41	65
20	140	2	11	17	32
20	155	1	1	1	3
30 N	110 E	0	0	0	2
30	125	6	12	22	35
30	140	7	13	18	28
30	155	0	0	1	3
40 N	125 E	0	0	5	7
40	140	0	2	5	12
40	155	1	1	1	1

DATE	1 JULY				
LAT	LON	A	B	C	D
10 N	110 E	0	0	0	3
10	125	1	7	15	24
10	140	1	2	3	4
10	155	1	2	3	7
20 N	110 E	4	15	29	41
20	125	19	41	54	84
20	140	5	13	26	50
20	155	0	1	4	11
30 N	110 E	0	0	0	4
30	125	8	18	35	52
30	140	1	7	21	42
30	155	0	0	3	5
40 N	125 E	2	4	7	13
40	140	1	4	6	17
40	155	0	0	0	2

DATE	16 JULY				
LAT	LON	A	B	C	D
10 N	110 E	0	0	0	4
10	125	1	8	18	33
10	140	1	2	3	4
10	155	1	3	4	7
10	170	0	0	0	1
20 N	110 E	8	21	36	48
20	125	19	47	69	97
20	140	12	26	40	70
20	155	3	5	8	19
20	170	0	0	1	2
30 N	110 E	0	0	0	3
30	125	11	26	50	65
30	140	6	21	36	52
30	155	0	3	7	12
30	170	0	0	1	1
40 N	125 E	3	9	12	19
40	140	1	5	12	25
40	155	0	1	3	8
40	170	0	0	1	2
40	175 W	0	0	0	1
50 N	170 E	0	0	0	1

DATE	1 AUGUST				
LAT	LON	A	B	C	D
10 N	110 E	0	0	0	6
10	125	1	3	7	11
10	140	1	3	4	4
10	155	1	3	4	8
10	170	0	0	0	2
20 N	110 E	12	24	43	59
20	125	15	53	80	113
20	140	15	30	58	98
20	155	5	10	14	29
20	170	1	2	3	5
30 N	110 E	0	0	0	5
30	125	16	34	61	77
30	140	16	35	53	74
30	155	2	9	14	23
30	170	1	1	1	1
30	175 W	0	0	1	1
40 N	125 E	3	8	14	24
40	140	4	9	23	40
40	155	1	3	6	14
40	170	0	0	1	3
40	175 W	0	0	0	1
50 N	140 E	0	0	1	2
50	170	0	0	0	1

DATE	16 AUGUST				
LAT	LON	A	B	C	D
10 N	110 E	0	0	0	5
10	125	1	3	3	8
10	140	1	2	2	2
10	155	1	5	11	16
10	170	0	0	3	4
20 N	110 E	13	28	48	68
20	125	17	58	88	123
20	140	14	36	72	111
20	155	4	9	21	39
20	170	1	4	6	10
20	175 W	0	0	1	3
30 N	110 E	0	0	0	7
30	125	12	29	62	87
30	140	18	34	58	81
30	155	3	10	18	32
30	170	1	1	2	5
30	175 W	0	0	1	1
40 N	125 E	3	10	14	28
40	140	8	16	29	47
40	155	2	6	10	18
40	170	0	0	2	3
40	175 W	0	0	0	1
50 N	140 E	0	1	2	3
50	170	0	0	0	1

DATE		1 SEPTEMBER			
LAT	LON	A	B	C	D
10 N	110 E	0	3	4	7
10	125	0	5	15	34
10	140	1	5	11	23
10	155	1	3	3	4
10	170	0	0	3	4
20 N	110 E	14	33	59	74
20	125	31	60	93	121
20	140	22	37	78	117
20	155	5	9	23	39
20	170	1	6	9	12
20	175 W	0	0	1	3
30 N	110 E	0	0	0	4
30	125	10	30	55	78
30	140	8	29	59	90
30	155	4	11	25	38
30	170	1	1	3	7
30	175 W	0	0	1	1
40 N	125 E	3	6	9	23
40	140	6	19	39	60
40	155	4	8	15	26
40	170	0	1	5	7
40	175 W	0	0	1	2
50 N	140 E	1	1	2	4
50	155	0	0	0	1
50	170	0	0	1	3

DATE		16 SEPTEMBER			
LAT	LON	A	B	C	D
10 N	110 E	0	4	4	10
10	125	0	9	16	33
10	140	1	2	2	6
10	155	1	4	5	7
10	170	0	0	4	5
20 N	110 E	22	37	53	73
20	125	26	60	85	116
20	140	20	42	77	111
20	155	5	9	24	48
20	170	3	5	10	15
20	175 W	0	0	1	3
30 N	110 E	0	0	0	4
30	125	4	22	46	68
30	140	11	29	57	88
30	155	7	9	24	46
30	170	1	2	6	10
30	175 W	0	0	1	1
40 N	125 E	1	2	7	16
40	140	9	16	34	57
40	155	3	11	17	27
40	170	2	2	6	8
40	175 W	0	0	1	1
50 N	140 E	0	1	2	4
50	155	0	0	0	1
50	170	1	1	2	2

DATE		1 OCTOBER			
LAT	LON	A	B	C	D
10 N	110 E	0	6	10	14
10	125	0	7	17	38
10	140	1	4	5	10
10	155	1	3	5	8
10	170	1	2	2	4
20 N	110 E	16	27	45	66
20	125	19	44	65	99
20	140	17	36	72	103
20	155	4	12	22	45
20	170	0	2	7	15
20	175 W	0	0	1	3
30 N	110 E	0	0	0	2
30	125	2	16	33	47
30	140	12	35	56	84
30	155	3	16	28	47
30	170	0	3	7	10
40 N	125 E	0	0	5	9
40	140	4	12	24	43
40	155	5	11	16	33
40	170	3	6	9	10
40	175 W	0	0	1	2
50 N	140 E	0	0	0	2
50	155	0	0	0	1
50	170	1	1	2	2

DATE		16 OCTOBER			
LAT	LON	A	B	C	D
10 N	110 E	1	2	2	2
10	125	1	7	11	21
10	140	1	5	7	13
10	155	1	3	4	6
10	170	1	2	2	5
20 N	110 E	6	16	35	50
20	125	9	28	51	84
20	140	15	29	54	86
20	155	6	13	21	37
20	170	1	1	3	11
30 N	125 E	1	7	18	31
30	140	13	33	55	79
30	155	6	16	24	46
30	170	1	3	5	9
40 N	125 E	0	0	0	2
40	140	0	3	12	32
40	155	3	9	15	29
40	170	2	5	8	11
40	175 W	0	0	0	2
50 N	140 E	0	0	0	1
50	155	0	0	0	1
50	170	0	0	1	2

		1 NOVEMBER			
DATE	LON	A	B	C	D
LAT					
10 N	110 E	1	2	2	2
10	125	1	3	4	7
10	140	1	2	2	3
10	155	1	4	5	7
10	170	0	3	4	7
20 N	110 E	4	10	22	30
20	125	12	25	44	75
20	140	8	19	45	69
20	155	4	10	16	29
20	170	1	1	1	7
30 N	125 E	0	4	12	25
30	140	17	26	46	62
30	155	8	16	24	39
30	170	0	2	6	9
40 N	140 E	0	0	4	14
40	155	1	4	10	22
40	170	0	3	7	7
40	175 W	0	0	0	1

		16 NOVEMBER			
DATE	LON	A	B	C	D
LAT					
10 N	110 E	1	2	2	3
10	125	1	2	3	5
10	140	1	2	2	3
10	155	1	4	6	8
10	170	1	2	2	4
20 N	110 E	2	4	13	20
20	125	14	24	39	63
20	140	5	16	35	58
20	155	0	5	10	19
20	170	0	0	2	3
30 N	125 E	1	2	8	18
30	140	11	19	32	44
30	155	4	10	15	26
30	170	0	1	3	5
40 N	140 E	0	0	1	6
40	155	1	3	6	15
40	170	0	0	3	5
40	175 W	0	0	0	1

DATE		1 DECEMBER			
LAT	LON	A	B	C	D
10N	110E	1	2	2	2
10	125	1	2	3	4
10	140	1	3	6	13
10	155	1	3	6	8
10	170	1	3	7	9
20N	110E	0	1	6	12
20	125	9	22	38	53
20	140	5	13	24	35
20	155	1	2	5	10
20	170	0	0	1	1
30N	125E	0	1	6	15
30	140	6	10	15	23
30	155	1	4	8	15
30	170	0	1	2	4
40N	140E	0	0	0	2
40	155	2	2	2	4
40	170	1	1	1	2

DATE		16 DECEMBER			
LAT	LON	A	B	C	D
10N	110E	1	4	6	6
10	125	1	2	5	7
10	140	1	2	5	9
10	155	1	2	4	7
10	170	1	2	2	4
20N	110E	0	0	0	3
20	125	5	9	21	34
20	140	4	10	16	23
20	155	1	1	5	6
20	170	0	0	1	1
30N	125E	0	0	0	9
30	140	1	2	7	13
30	155	0	0	3	7
30	170	0	0	0	2
40N	140E	0	0	0	1
40	155	1	1	2	3
40	170	1	1	1	1

U135837

Not releasable to foreign nationals.
Shelved numerically in the vault. *a*

